

**South Carolina  
Department of Health and Environmental Control**

**Total Maximum Daily Load Development for  
Twenty-five Mile Creek: (HUC 03050104-060);  
Station CW-080  
Fecal Coliform Bacteria**

**March 31, 2004**

**Bureau of Water**





## **Abstract**

The Clean Water Act requires states to develop Total Maximum Daily Loads (TMDL) for waters that do not meet water quality standards. Twenty-five Mile Creek, a tributary of the Wateree River, is impaired for recreational uses by fecal coliform. A TMDL has been developed for Twenty-five Mile Creek, in Kershaw, Richland, and Fairfield Counties, South Carolina. This watershed is largely rural and suburban. The predominant land use is forest. Potential sources of fecal coliform bacteria were identified to be cattle with access to streams, failing septic systems, and runoff from pastures and developed land.

The load-duration curve methodology was used to calculate the existing load and the TMDL load for Twenty-five Mile Creek. The existing load was estimated to be  $5.2\text{E}+12$  cfu/day. The TMDL load was determined to be  $1.65\text{E}+12$  cfu/day, consisting of wasteload allocation for three MS4s, expressed as percent reduction of 70 %, and the Load Allocation of  $1.51\text{E}+12$  cfu/day and margin of safety of  $8.0\text{E}+10$  cfu/day. This TMDL requires a 71 % reduction in the existing load to the creek. Several TMDL implementation strategies to bring about these reductions are suggested.

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## **Twenty-five Mile Creek (HUC 03050104-060)**

### **1.0 INTRODUCTION:**

#### **1.1 Background**

Levels of fecal coliform bacteria can be elevated in water bodies as the result of both point and nonpoint sources of pollution. Section 303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop total maximum daily loads (TMDLs) for water bodies that are not meeting designated uses under technology-based pollution controls. The TMDL process establishes the allowable loadings of pollutants or other quantifiable parameters for a water body based on the relationship between pollution sources and in stream water quality conditions so that states can establish water quality-based controls to reduce pollution and restore and maintain the quality of water resources (USEPA 1991).

#### **1.2 Watershed Description**

The watershed of Twenty-five Mile Creek is mostly in Kershaw County, but also extends into Richland and Fairfield Counties. The watershed is partly in the Piedmont Ecoregion and partly in the Southern Plains Ecoregion. Twenty-five Mile Creek flows into the Wateree River (Figure 1). The watershed is mostly rural, but some of the towns of Blythewood, Elgin, and Lugoff are in the watershed. Approximately 13,000 people lived in the unsewered parts of the watershed in 2000. Essentially all of the 11-digit watershed is included in this TMDL. The area of the watershed is 322 km<sup>2</sup> (124 mi<sup>2</sup>).

There is one water quality monitoring station on Twenty-five Mile Creek. Station CW-080 is located at the S-28-5 bridge near Lugoff (Figure 1).

The predominant land uses (NLCD) in the watershed is forest, accounting for 70% of the land (Figure 2; Table 1). The next largest land use is classified as agricultural - cropland (18%). However, according to Mike Newman (NRCS, personal communication, 2003), there is now very little cropland in the watershed but more pasture. Wetlands account for 6 % of the land; built-up or developed land account for 3 %. The NLCD data were collected in the early 1990's and are somewhat out of date. This watershed is close enough to the population center of Columbia, so that it is receiving growth pressures.

#### **1.3 Water Quality Standard**

The impaired stream segment, Twenty-five Mile Creek, is designated as Class Freshwater. Waters of this class are described as follows:

“Freshwaters suitable for primary and secondary contact recreation and as a source for drinking water supply after conventional treatment in accordance with the requirements of the Department. Suitable for fishing and the survival and propagation of a balanced indigenous aquatic community of fauna and flora. Suitable also for industrial and agricultural uses.” (R.61-68)

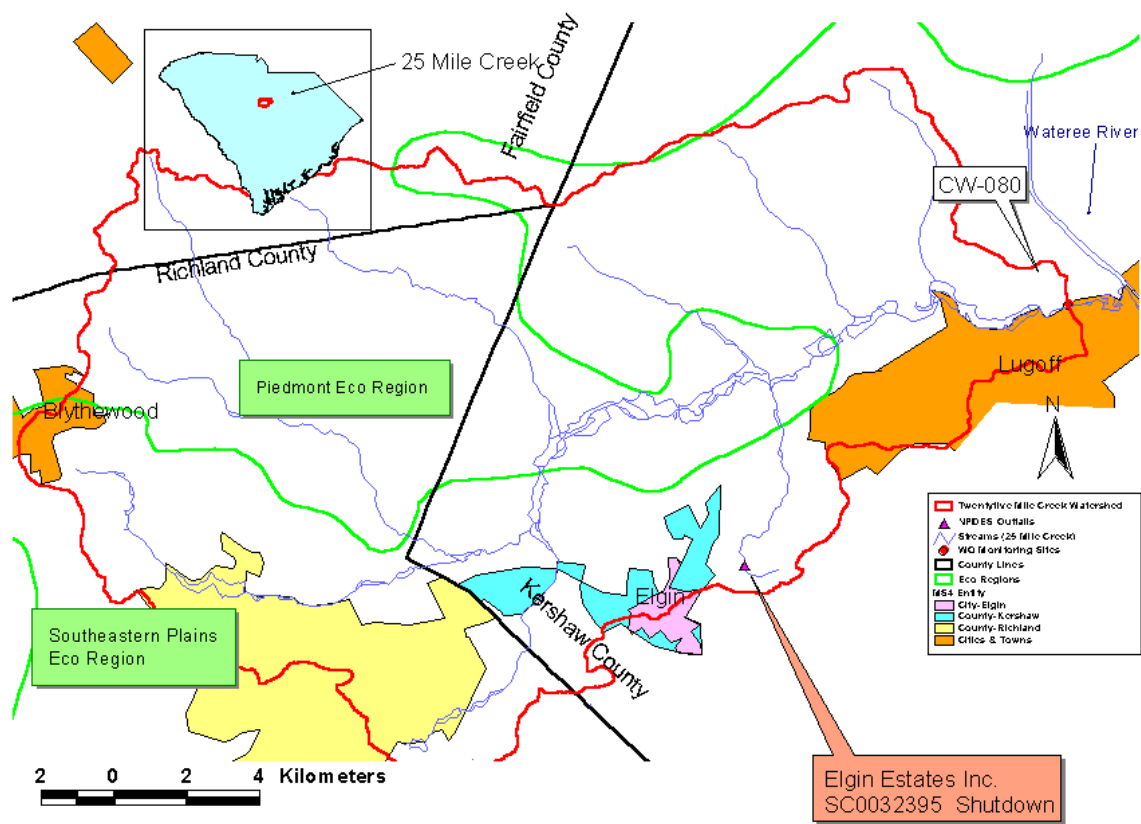


Figure 1. Map of the Twenty-five Mile Creek watershed.

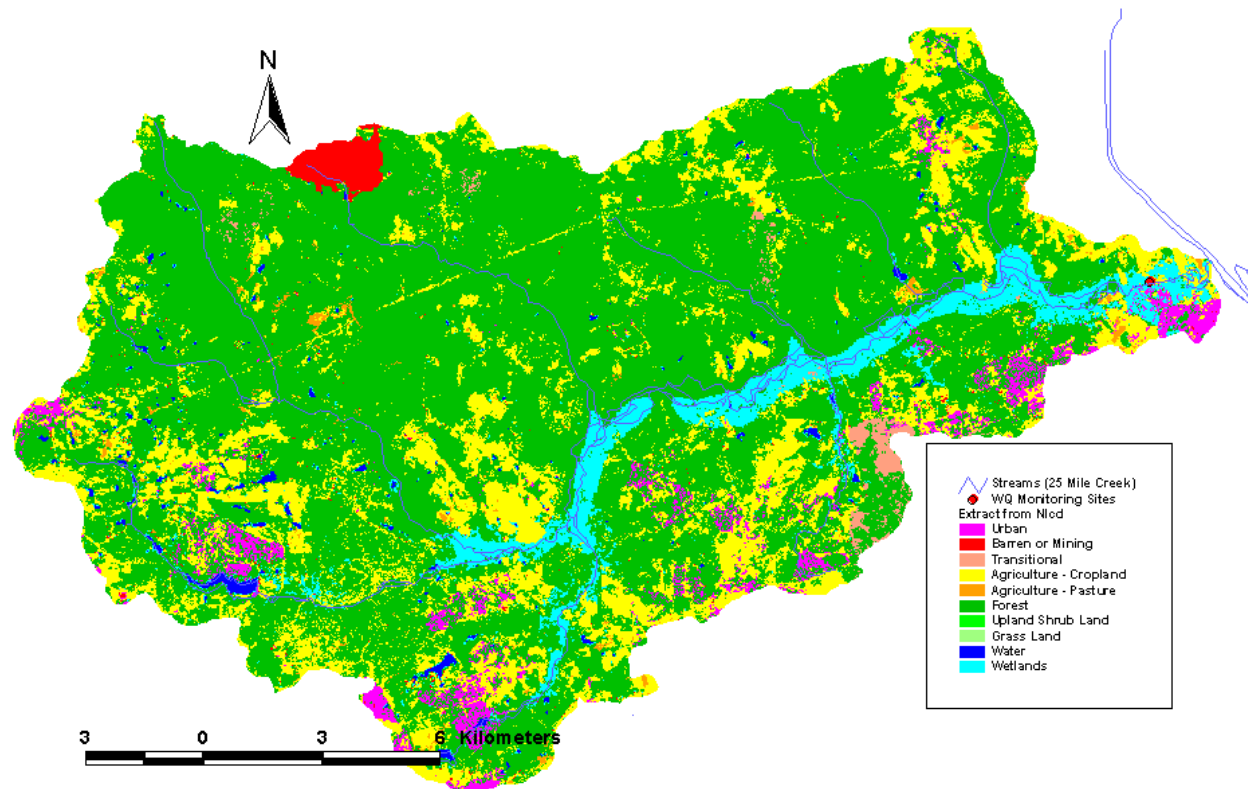


Figure 2. Map showing land uses in the Twenty-five Mile Creek watershed.



South Carolina's standard for fecal coliform in Freshwater is:

“Not to exceed a geometric mean of 200/100 ml, based on five consecutive samples during any 30 day period; nor shall more than 10% of the total samples during any 30 day period exceed 400/100 ml.”(R.61-68).

Table 1. Land uses in the Twenty-five Mile Creek watershed.

| Land Use Classes              | Cells          | Area<br>(hectares) | Area<br>(acres) | Percent-<br>age |
|-------------------------------|----------------|--------------------|-----------------|-----------------|
| Built-up                      |                | 977.0              | 2,414.3         | 3%              |
| Barren or Mining              |                | 337.5              | 834.0           | 1%              |
|                               |                |                    |                 |                 |
| Transitional                  | 2,363          | 212.7              | 525.5           | 1%              |
| <b>Forest</b>                 |                | <b>22,496.2</b>    | <b>55,589.1</b> | <b>70%</b>      |
|                               |                |                    |                 |                 |
| Agriculture - Pasture         | 3,057          | 275.1              | 679.9           | 1%              |
| <b>Agriculture - Cropland</b> |                | <b>5,903.2</b>     | <b>14,587.0</b> | <b>18%</b>      |
|                               |                |                    |                 |                 |
| <b>Wetlands</b>               |                | <b>1,790.2</b>     | <b>4,423.6</b>  | <b>6%</b>       |
|                               |                |                    |                 |                 |
| Water                         | 2,801          | 252.1              | 622.9           | 1%              |
|                               |                |                    |                 |                 |
| <b>Totals</b>                 | <b>358,267</b> | <b>32,244.0</b>    | <b>79,676</b>   | <b>100%</b>     |

## 2.0 WATER QUALITY ASSESSMENT

An assessment of water quality data collected in 1996 through 2000 at water quality monitoring stations CW-080 indicated that Twenty-five Mile Creek at this location is impaired for recreational use. In addition to being listed on the 2002 303(d) list, Twenty-five Creek was also on the 1998 and 2000 lists. Waters in which no more than 10% of the samples collected over a five year period are greater than 400 fecal coliform counts or cfu / 100 ml are considered to comply with the South Carolina water quality standard for fecal coliform bacteria. Waters with more than 10 percent of samples greater than 400 cfu/ 100 ml are considered impaired and placed on South Carolina's 303(d) list for fecal coliform bacteria. During the assessment period (1996-2000), 24 % of the samples did not meet the fecal coliform criterion at CW-080. Stream fecal coliform data are provided in Appendix A.

Comparison of fecal coliform concentrations in Twenty-five Mile Creek and precipitation measured at the Columbia Metro Airport (SC001939) is plotted in Figure 3. There appears to be little relationship between rainfall and fecal coliform concentrations, though the two highest fecal coliform concentrations are associated with moderate rainfall events. The highest rainfall events are not associated with high fecal coliform. Rainfall at Columbia may not be representative of rainfall during summer when rain events are frequently local. Most of the samples were collected during the warm months. Fecal coliform excursions in Twenty-five Mile Creek appear to be mostly associated with continuous sources, though occasionally they are caused by rainfall.

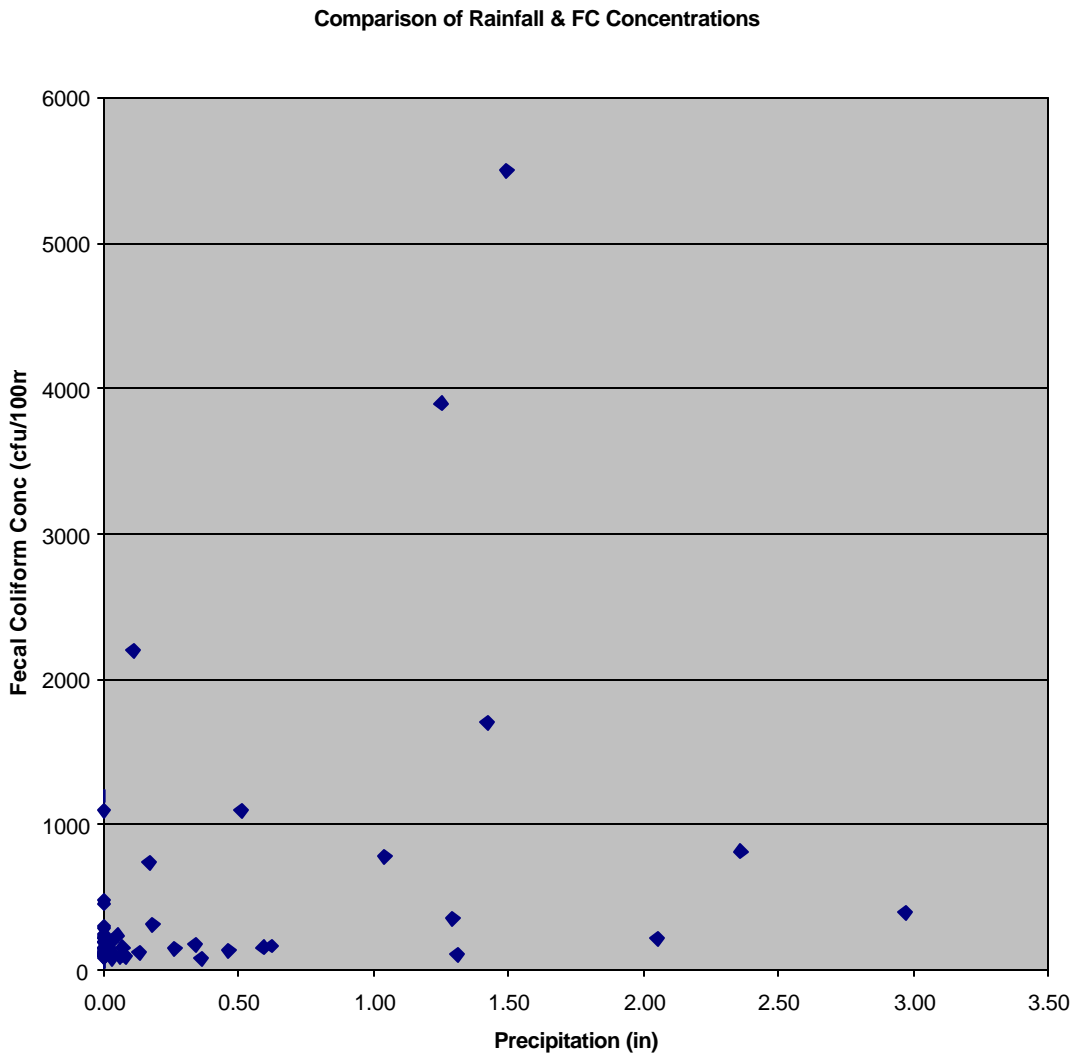


Figure 3. Comparison between precipitation and fecal coliform concentrations in Twenty-five Mile Creek.

### **3.0 SOURCE ASSESSMENT AND LOAD ALLOCATION**

Fecal coliform bacteria enter surface waters from both point and nonpoint sources. Poorly treated municipal sewage has been a major source of fecal coliform, but with improved treatment and enforcement this is not usually the case now. All point sources must have a NPDES permit. NPDES permit holders in South Carolina that discharge sanitary wastewater must meet the state standard for fecal coliform at the outfall.

#### **3.1 Point Sources in the Twenty-five Mile Creek Watershed**

##### **3.1.1 Continuous Point Sources**

There are no active NPDES facilities that discharge fecal coliform bacteria in this watershed. The Kennecot Ridgeway Gold Mine (SC0041378) (area colored red in Figure 2), located on Bear Creek, a tributary, discharges process wastewater only. Elgin Estates Inc. (SC0032395), a small wastewater treatment facility on a tributary, operated until the middle of 2000. This facility is now shutdown and its permit inactivated on Dec. 31, 2000. The Elgin Estates WWTF discharge exceeded permit limits for fecal coliform several times during the period of record and may have contributed to the impairment of Twenty-five Mile Creek.

##### **3.1.2 Municipal Separate Storm Sewer Systems**

Phase II of EPA's NPDES stormwater rules define certain urbanized areas as small Municipal Separate Storm Sewer Systems or MS4s. The rules require the municipality or agency responsible for the small MS4s to obtain a NPDES permit and to develop a storm water management program. The stormwater programs are to be designed to reduce discharges of pollutants from storm sewers to the "maximum extent practicable", protect water quality, and satisfy appropriate water quality requirements of the Clean Water Act.

Several small areas, which are contiguous with the City of Columbia, within the watershed have been designated as MS4s (Figure 4). These areas, parts of Richland and Kershaw Counties, have or will have NPDES MS4 (Municipal Separate Storm Sewer System) permits. These permitted sewer systems will be treated as point sources in the TMDL calculations below. However for modeling purposes all urban areas will be evaluated together as urban nonpoint sources.

#### **3.2 Nonpoint Sources in Twenty-five Mile Creek Watershed**

##### **3.2.1 Wildlife**

Wildlife (mammals and birds) are contributors of fecal coliform bacteria to surface waters. Wildlife wastes are carried into nearby streams by runoff following rainfall or deposited directly in streams. Deer are the largest and probably most noticeable mammals in this area. The SC Department of Natural Resources (Charles Ruth, DNR Deer Project Supervisor, personal communication, 2000) has estimated a density of about 45 deer/mi<sup>2</sup> for this area. Deer habitat includes forest, cropland,

pastures, and some suburban areas. Waterfowl also may be significant contributors of fecal coliform bacteria, particularly in urban and suburban ponds, which often provide a desirable habitat for geese and ducks. Forest lands, which typically have only low concentrations of wildlife as sources of fecal coliform bacteria, usually have low loading rates for fecal coliform bacteria.

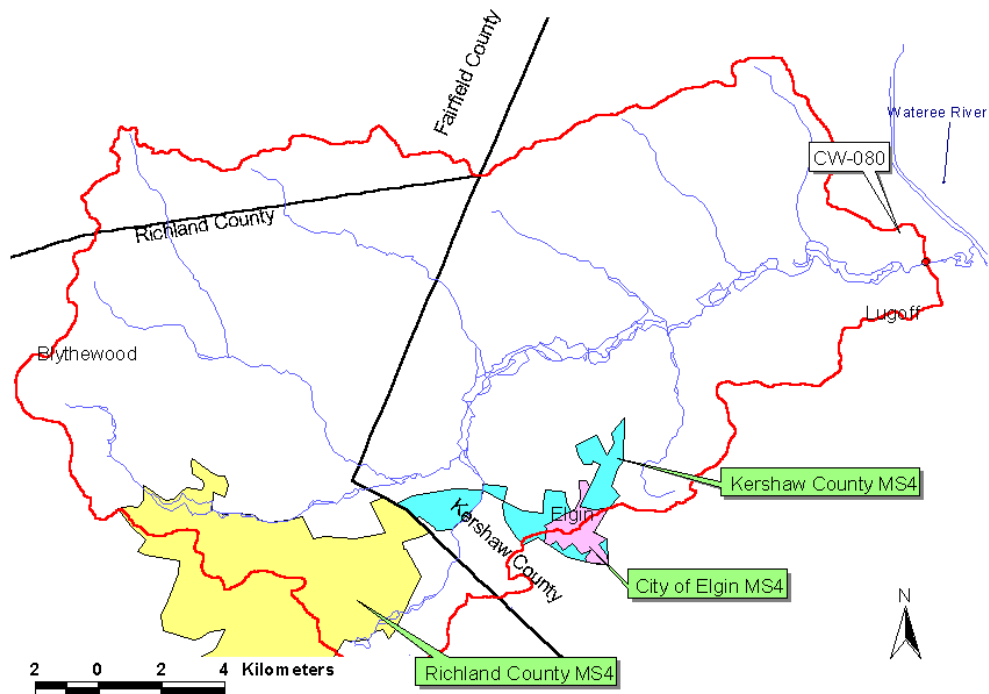


Figure 4. Areas within the Twenty-five Mile Creek watershed that have been designated as MS4s.

### 3.2.2 Land Application of Manure

There are two permitted animal feeding operations in this watershed. One raises broilers; it is permitted for 56,000 broilers. This facility has fields within the watershed that are permitted for land application of manure. The other is a quail raising facility. It is permitted for 40,000 birds. However, all the fields permitted to receive manure from this facility are in Lee County.

Most of the litter from these facilities is carried out of the watershed. The manure that is not taken out of the watershed is typically applied to pasture.

### 3.2.3 Grazing Animals

Livestock such as cattle, goats, and horses spend most of their time grazing on pasture land. Runoff from rainfall washes some of the manure deposited in the pastures into nearby streams. The number of cattle in the watershed was estimated from the number of cattle in each county from the 1997 Agricultural Atlas and the proportion of pasture/hay land by county in the watershed compared to amount of pasture /hay land in the county. Using this method 384 cattle and calves are estimated to be in the Twenty-five Mile watershed. There are probably as many horses as cattle in the watershed, which has many small hobby farms (Mike Newman, personal communication, NRCS 2003).

Grazing cattle and other livestock may contaminate streams with fecal coliform bacteria in two ways. Runoff from pastures may carry the bacteria into streams following rain events. Cattle that are allowed access to streams deposit manure directly into the streams. Manure deposited in streams can be a significant source of fecal coliform bacteria. Loading of fecal coliform bacteria to Twenty-five Mile Creek by this route is possibly a significant source but not the principal source of fecal coliform bacteria to the stream. The number of estimated cattle is relatively small because the amount of pasture land is small. The amount of cropland is much larger according to the land use database. The NRCS and personal observation suggest that the amount of pasture is larger than the amount of cropland. This would suggest that the number of cattle in the watershed is an underestimate.

### 3.2.4 Failing Septic Systems

Septic systems that do not function properly may leak sewage unto the land surface where it can reach nearby streams. Failing septic systems include improperly designed or constructed systems and systems that no longer function. The number of households that have septic systems was estimated using a GIS. The 2000 census database layer was compared to a sewer line data layer theme and the boundaries of the Twenty-five Mile Creek watershed. In 2000 there were an estimated 12,800 people in some 4700 households in the Twenty-five Mile watershed that do not have sewer service. Assuming each household had its own system, there were 4700 septic systems in the watershed. Depending on their failure rate, septic systems could be a somewhat significant source of fecal coliform. There is no accurate estimate of the failure rate in this watershed, but Schueler (1999) cited several studies that reported failure rates ranging from 5 to 39 %. Even at the high end of the range of failure rates, septic systems are likely to be only a minor source of fecal coliform loading to Twenty-five Mile Creek.

The 1990 census indicated that at least twenty houses had 'other' waste treatment (not sewer or septic systems); but this data is not available from the 2000 census. If these houses continue to be occupied and are still not sewered or have septic systems, they probably have a higher potential for contributing fecal coliform to Twenty-five Mile Creek than other houses, because they may have wastewater piped directly into a creek or indirectly through ditches or overland.

### 3.2.5 Runoff from Built-up Land

The percentage of developed land in this watershed is small, about 3 %. Runoff from this land use is therefore likely small. The higher percentage of impervious surfaces and the concentration of dogs, cats, and the wildlife that live in developed areas increase the loading from built-up or developed land.

## 4.0 LOAD-DURATION METHOD

Load-duration curves were developed as a method of developing TMDLs that applies to all hydrologic conditions. The load-duration curve method uses the cumulative frequency distribution of stream flow and pollutant concentration data to estimate the existing and the TMDL loads for a water body. Development of the load-duration curve is described in this chapter.

In the ideal situation a long period of record for flow data would be available for the water body of interest. A longer period of record increases the confidence in the results of the load-duration method. Twenty-five Mile Creek, like most small streams in South Carolina is not gauged. Black Creek, in Chesterfield County, is a comparable-sized, gauged, nearby stream, with similar land uses and topography. Data from the gauge (USGS 02130900) on Black Creek near McBee, South Carolina for the period of record (October 1959 to Sept 30, 2001) were used to generate the flow-duration curve (Appendix C). The Black Creek watershed is slightly smaller, 280 km<sup>2</sup> compared to 322 km<sup>2</sup> for Twenty-five Mile Creek. Black Creek is completely in the Southeastern Plains Eco-region, while Twenty-five Mile Creek is about 60 % in this Eco-region with the rest in the Piedmont Eco-region.

The flow for Twenty-five Mile Creek was estimated by multiplying the daily flow rates from Black Creek by the ratio of the Twenty-five Mile Creek drainage area to that of Black Creek (1.148). The flows were ranked from low to high and the values that exceed certain selected percentiles determined. The load-duration curve was generated by calculating the load from the observed fecal coliform concentrations, the flow rate that corresponds to the date of sampling, and a conversion factor for the difference in units. The load was plotted against the appropriate flow recurrence interval to generate the curve (Figure 4). The target line was created by calculating the allowable load from the flow and the appropriate fecal coliform standard concentration in the same manner. Sample loads above this line are violations of the standard, while loads below the line are in compliance.

The trend line was determined for loads that are above the target line. The trend line for Twenty-five Mile Creek with the best fit was an exponential curve; the  $r^2$  was 0.7143. The equation for the line and supporting data are provided in Appendix B. This trend line represents samples that violated the water quality standard. The existing load to Twenty-five Mile Creek was calculated from values along this trend line. Most of the violating loads were between the 10 % and 90 % flow

recurrence intervals. The existing load is the average of loads from the 10 % to 90 % recurrence intervals at 5 % intervals, i.e. 0, 15, 20, 25 ... 90.

The TMDL load is calculated from the target line in the same manner, that is the average of loads at 5 % intervals from 10 % to 90 %. The Load Allocation values are 95 % of the loads from the target line, that is the TMDL load minus the Margin of Safety. Calculations for both existing and TMDL loads are provided in Appendix B.

## **5.0 DEVELOPMENT OF TOTAL MAXIMUM DAILY LOAD**

A total maximum daily load (TMDL) for a given pollutant and water body is comprised of the sum of individual wasteload allocations (WLAs) for point sources, and load allocations (LAs) for both nonpoint sources and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, to account for the uncertainty in the relationship between pollutant loads and the quality of the receiving water body. Conceptually, this definition is represented by the equation:

$$\text{TMDL} = \mathbf{3} \text{ WLAs} + \mathbf{3} \text{ LAs} + \text{MOS}$$

The TMDL is the total amount of pollutant that can be assimilated by the receiving water body while still achieving water quality standards. In TMDL development, allowable loadings from all pollutant sources that cumulatively amount to no more than the TMDL must be established and thereby provide the basis to establish water quality-based controls.

For most pollutants, TMDLs are expressed as a mass load (e.g., kilograms per day). For bacteria, however, TMDLs are expressed in terms of number (#), cfu, or organism counts (or resulting concentration), in accordance with 40 CFR 130.2(l).

### **5.1 Critical Conditions**

The most critical condition for Twenty-five Mile Creek occurs when a rainfall event that produces runoff follows a long period of low flow. At low flow rates the continual sources like poorly functioning wastewater treatment plants, cattle in the streams, and failing septic systems cause the concentration of the fecal coliform in the creek to rise as dilution decreases. During the long dry period, fecal coliform bacteria build up on the land surface. Rainfall flushes much of this accumulation into the creek with runoff, which causes the already high concentrations to increase further.

Standard violations occurred across the whole range of flows, but were more frequent at low flows. The inclusion of the wide range of flow conditions in the load-duration curve analysis insures that the critical conditions are protected. Existing and TMDL loads were calculated from the 10 – 90 % flow exceedence intervals. The extreme high and low flow conditions may not be protected by this TMDL.

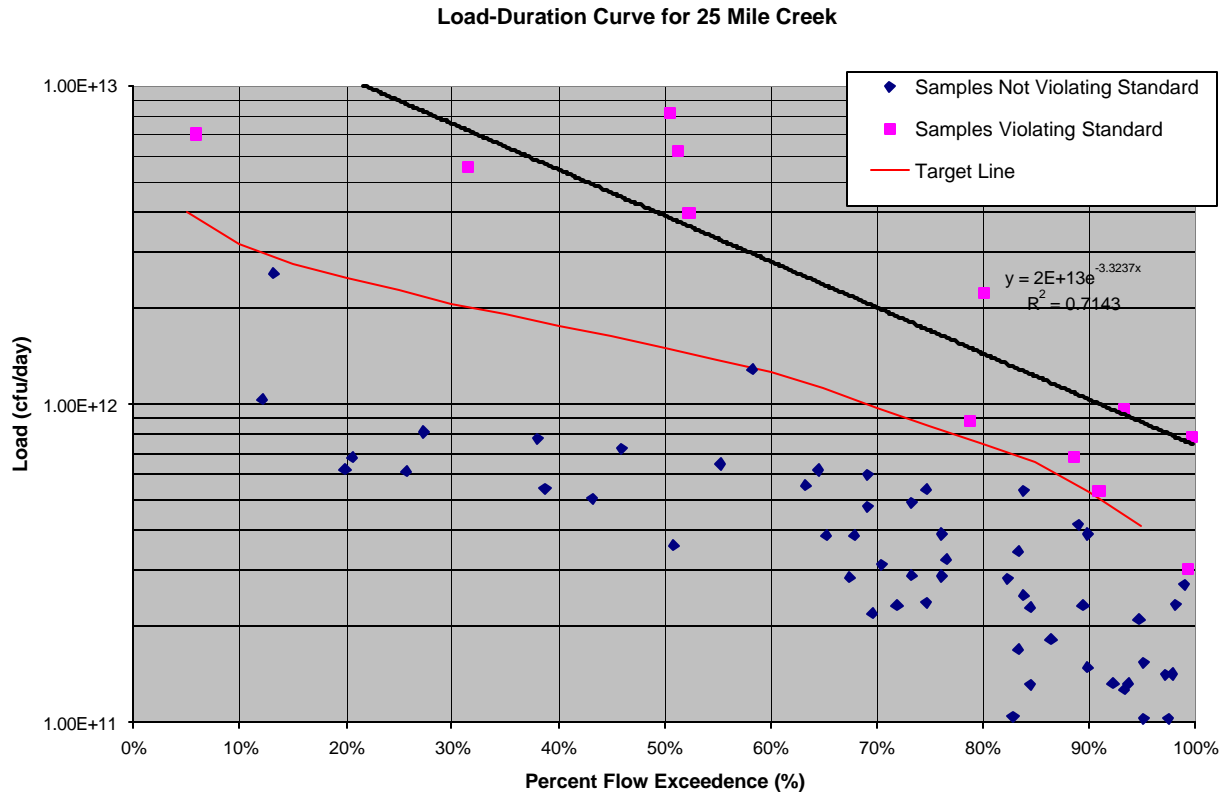


Figure 5. Load-Duration Curve for Twenty-five Mile Creek at CW-080.

## 5.2 Existing Load

The existing load was calculated from the trend line of observed values that exceeded the water quality standard and were between and including 10 and 90 % recurrence limits. Loadings from all sources are included in this figure: failing septic systems, cattle-in-streams, and loading from runoff. The total existing load for CW-080 is 5.18E+12 cfu/day.

## 5.3 Margin of Safety

The margin of safety (MOS) may be explicit and/or implicit. The explicit margin of safety is 5 % for this TMDL or 20 cfu/ 100ml. For CW-080 the MOS is equivalent to 8.0E+10 cfu/day.

## 5.4 Total Maximum Daily Load

The Total Maximum Daily Load (TMDL) represents the maximum load the stream may carry and meet the water quality standard for the pollutant of interest. For this TMDL the load will be expressed as cfu/day (colony forming units/day).



There are no active NPDES facilities that discharge sanitary wastewater in this watershed. However, there are three municipalities in the watershed that have or will have NPDES MS4 permits. Richland County became covered under NPDES Phase I in April of 2000. A designated area in Kershaw County will eventually be covered under a NPDES phase II stormwater permit. The reduction percentages in this TMDL apply also to the fecal coliform waste load attributable to those areas of the watershed which are covered or will be covered under NPDES MS4 (Municipal Separate Storm Sewer System) permits. Compliance by these municipalities with the terms of their individual MS4 permits will fulfill any obligations they have towards implementing this TMDL

Table 2. TMDL components for Twenty-five Mile Creek.

| Impaired Station | WLA MS4 % Reduction | LA cfu/day | MOS cfu/day | TMDL cfu/day | Target cfu/day | Percent Reduction |
|------------------|---------------------|------------|-------------|--------------|----------------|-------------------|
| CW-080           | 71                  | 1.51E+12   | 8.0E+10     | 1.59E+12     | 1.51E+12       | 71                |

The target loading value is the load to the creek that it can receive and meet the water quality standard. It is simply the TMDL minus the MOS. The target loading for Twenty-five Mile Creek requires a reduction of 71 % from the current load of 5.18E+12 cfu/day for CW-080.

## 6.0 IMPLEMENTATION

As discussed in the *Implementation Plan for Achieving Total Maximum Daily Load Reductions From Nonpoint Sources for the State of South Carolina* (SCDHEC,1998), South Carolina has several tools available for implementing this nonpoint source TMDL. Specifically, SCDHEC's animal agriculture permitting program addresses animal operations and land application of animal wastes. In addition, SCDHEC will work with the existing agencies in the area to provide nonpoint source education in the Twenty-five Mile Creek Watershed. Local sources of nonpoint source education and assistance include Clemson Extension Service, the Natural Resource Conservation Service (NRCS), the Kershaw, Richland, and Fairfield County Soil and Water Conservation Services, and the South Carolina Department of Natural Resources. Clemson Extension Service offers a 'Farm-A-Syst' package to farmers. Farm-A-Syst allows the farmer to evaluate practices on their property and determine the nonpoint source impact they may be having. It recommends best management practices (BMPs) to correct nonpoint source problems on the farm. NRCS can provide cost share money to land owners installing BMPs.

SCDHEC is empowered under the State Pollution Control Act to perform investigations of and pursue enforcement for activities and conditions which threaten the quality of waters of the state. In addition, other interested parties (universities, local watershed groups, etc.) may apply for section 319 grants to install BMPs that will reduce fecal coliform loading to Twenty-five Mile Creek. TMDL implementation projects are given highest priority for 319 funding.

The iterative BMP approach as defined in the general storm water NPDES MS4 permit is expected to provide significant implementation of this TMDL. Discovery and removal of illicit storm drain cross connection is one important element of the storm water NPDES permit. Public nonpoint source pollution education is another.

In addition to the resources cited above for the implementation of this TMDL in the Twenty-five Mile Creek Watershed, Clemson Extension has developed a Home-A-Syst handbook that can help urban or rural homeowners reduce sources of NPS pollution on their property. This document guides homeowners through a self-assessment, including information on proper maintenance practices for septic tanks. SCDHEC also employs a nonpoint source educator who can assist with distribution of these tools as well as provide additional BMP information.

Using existing authorities and mechanisms, these measures will be implemented in the Twenty-five Mile Creek Watershed in order to bring about a 71 % reduction in fecal coliform bacteria loading to Twenty-five Mile Creek. DHEC will continue to monitor, according to the basin monitoring schedule, the effectiveness of implementation measures and evaluate stream water quality as the implementation strategy progresses.

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## APPENDIX A Fecal Coliform Data for Twenty-five Mile Creek at CW-080

| Date      | FC (cfu/<br>100ml) | Date      | FC (cfu/<br>100ml) | Date     | FC (cfu/<br>100ml) |
|-----------|--------------------|-----------|--------------------|----------|--------------------|
| 21-May-90 | 160                | 9-May-95  | 110                | 1/3/01   | 160                |
| 12-Jun-90 | 95                 | 13-Jun-95 | 1100               | 2/1/01   | 130                |
| 16-Jul-90 | 120                | 5-Jul-95  | 240                | 4/5/01   | 97                 |
| 7-Aug-90  | 220                | 16-Aug-95 | 200                | 5/1/01   | 120                |
| 18-Sep-90 | 160                | 20-Sep-95 | 290                | 6/20/01  | 120                |
| 16-Oct-90 | 230                | 4-Oct-95  | 3900               | 6/21/01  | 120                |
| 29-May-91 | 2200               | 14-May-96 | 160                | 7/23/01  | 120                |
| 12-Jun-91 | 190                | 26-Jun-96 | 160                | 8/15/01  | 1400               |
| 2-Jul-91  | 110                | 22-Jul-96 | 170                | 9/11/01  | 380                |
| 12-Aug-91 | 5500               | 5-Aug-96  | 100                | 10/18/01 | 150                |
| 11-Sep-91 | 250                | 10-Oct-96 | 780                | 11/14/01 | 320                |
| 21-Oct-91 | 460                | 14-May-97 | 100                | 12/6/01  | 310                |
| 20-May-92 | 120                | 19-Jun-97 | 200                |          |                    |
| 17-Jun-92 | 150                | 1-Jul-97  | 80                 |          |                    |
| 28-Jul-92 | 110                | 5-Aug-97  | 110                |          |                    |
| 26-Aug-92 | 1200               | 2-Sep-97  | 150                |          |                    |
| 15-Sep-92 | 150                | 9-Oct-97  | 300                |          |                    |
| 22-Oct-92 | 60                 | 9-Mar-98  | 820                |          |                    |
| 18-Nov-92 | 110                | 2-Apr-98  | 740                |          |                    |
| 8-Dec-92  | 180                | 27-May-98 | 190                |          |                    |
| 19-Jan-93 | 100                | 18-Jun-98 | 90                 |          |                    |
| 11-Feb-93 | 110                | 30-Jul-98 | 1100               |          |                    |
| 4-Mar-93  | 360                | 5-Aug-98  | 220                |          |                    |
| 1-Apr-93  | 140                | 24-Sep-98 | 190                |          |                    |
| 18-May-93 | 140                | 21-Oct-98 | 220                |          |                    |
| 2-Jun-93  | 150                | 5/19/99   | 140                |          |                    |
| 13-Jul-93 | 100                | 6/2/99    | 110                |          |                    |
| 18-Aug-93 | 480                | 7/8/99    | 860                |          |                    |
| 8-Sep-93  | 320                | 8/19/99   | 290                |          |                    |
| 5-May-94  | 1700               | 9/2/99    | 460                |          |                    |
| 8-Jun-94  | 400                | 10/21/99  | 190                |          |                    |
| 9-Aug-94  | 170                | 5/9/00    | 140                |          |                    |
| 25-Aug-94 | 170                | 6/7/00    | 420                |          |                    |
| 15-Sep-94 | 60                 | 7/18/00   | 110                |          |                    |
| 18-Oct-94 | 120                | 8/3/00    | 130                |          |                    |

# APPENDIX B Mean Daily Load (1/1991 - 5/2003): cfu/day

## Elgin Estates WWTF NPDES Permit # SC0032395

| Date     | Flow (mgd)   |             | Fecal Coliform (cfu/100ml) |      |             |      |
|----------|--------------|-------------|----------------------------|------|-------------|------|
|          | Monthly Mean | Monthly Max | Monthly Mean               |      | Monthly Max |      |
|          |              |             | C                          |      | C           |      |
| 12/31/91 |              | 0.056       |                            | 3000 |             | 3000 |
| 7/31/92  |              | 0.003       |                            | 200  |             | 200  |
| 8/31/92  |              | 0.003       |                            | 200  |             | 200  |
| 9/30/92  |              | 0.003       |                            | 200  |             | 200  |
| 10/31/92 |              | 0.003       |                            | 200  |             | 200  |
| 11/30/92 |              | 0.004       |                            | 200  |             | 200  |
| 12/31/92 |              | 3           |                            | 2    |             | 2    |
| 1/31/93  |              | 0.118       |                            | 200  |             | 200  |
| 2/28/93  |              | 0.118       |                            | 200  |             | 200  |
| 3/31/93  |              | 0.056       |                            | 4    |             | 4    |
| 4/30/93  |              | 0.0568      |                            | 2700 |             | 2700 |
| 5/31/93  |              | 0.201       |                            | 200  |             | 200  |
| 7/31/93  |              | 0.026       |                            | 10   |             | 10   |
| 8/31/93  |              | 0.012       |                            | 10   |             | 10   |
| 1/31/94  |              | 0.032       | <                          | 10   | <           | 10   |
| 4/30/94  |              | 0.025       | <                          | 10   | <           | 10   |
| 5/31/94  |              | 0.02        | <                          | 10   | <           | 10   |
| 6/30/94  |              | 0.016       |                            |      |             |      |
| 7/31/94  |              | 0.01        |                            | 10   |             | 10   |
| 8/31/94  |              | 0.015       |                            | 80   |             | 80   |
| 9/30/94  | 0.015        | 0.015       |                            | 2    |             | 2    |
| 10/31/94 |              | 0.017       |                            | 10   |             | 10   |
| 1/31/95  | 0.022        | 0.022       | <                          | 2    | <           | 2    |
| 5/31/95  | 0.015        | 0.015       | <                          | 2    | <           | 2    |
| 8/31/95  | 0.015        | 0.015       | <                          | 2    | <           | 2    |
| 1/31/96  |              |             |                            | 2    |             | 2    |
| 2/29/96  |              |             |                            | 4    |             | 4    |
| 3/31/96  |              |             |                            | 2    |             | 2    |
| 4/30/96  |              |             |                            | 10   |             | 10   |
| 5/31/96  | 0.011        | 0.011       |                            | 4    |             | 4    |
| 6/30/96  | 0.011        | 0.011       |                            | 72   |             | 72   |
| 7/31/96  | 0.009        | 0.009       | <                          | 2    | <           | 2    |
| 8/31/96  | 0.006        | 0.006       |                            | 4.8  |             | 4.8  |
| 9/30/96  | 0.004        | 0.004       |                            | 737  |             | 9700 |
| 10/31/96 | 0.004        | 0.004       |                            | 5300 |             | 5300 |

| Date     | Flow (mgd)   |             | Fecal Coliform (cfu/100ml) |      |             |      |
|----------|--------------|-------------|----------------------------|------|-------------|------|
|          | Monthly Mean | Monthly Max | Monthly Mean               |      | Monthly Max |      |
|          |              |             | C                          |      | C           |      |
| 11/30/96 | 0.011        | 0.011       | <                          | 2    | <           | 2    |
| 12/31/96 | 0.009        | 0.009       | <                          | 2    | <           | 2    |
| 1/31/97  | 0.009        | 0.009       | <                          | 2    | <           | 2    |
| 2/28/97  | 0.015        | 0.015       |                            | 7100 |             | 7100 |
| 3/31/97  | 0.03         | 0.03        |                            | 290  |             | 290  |
| 4/30/97  | 0.017        | 0.017       |                            | 43   |             | 20   |
| 5/31/97  | 0.014        | 0.014       | <                          | 2    | <           | 2    |
| 6/30/97  | 0.014        | 0.014       | <                          | 2    | <           | 2    |
| 7/31/97  | 0.017        | 0.017       |                            | 2    |             | 2    |
| 8/31/97  | 0.012        | 0.012       | <                          | 2    | <           | 2    |
| 9/30/97  | 0.012        | 0.012       |                            | 2    |             | 2    |
| 10/31/97 | 0.011        | 0.011       |                            | 40   |             | 40   |
| 11/30/97 | 0.014        | 0.014       |                            | 64.8 |             | 2100 |
| 12/31/97 | 0.014        | 0.014       | <                          | 2    | <           | 2    |
| 1/31/98  | 0.011        | 0.011       | <                          | 2    | <           | 2    |
| 2/28/98  | 0.028        | 0.028       | <                          | 2    | <           | 2    |
| 3/31/98  | 0.093        | 0.093       | <                          | 2    | <           | 2    |
| 4/30/98  | 0.065        | 0.065       |                            | 2    |             | 2    |
| 5/31/98  | 0.035        | 0.035       |                            | 2    |             | 2    |
| 6/30/98  | 0.0597       | 0.0597      |                            | 2    |             | 2    |
| 7/31/98  | 0.0249       | 0.0249      |                            | 6    |             | 6    |
| 8/31/98  | 0.0146       | 0.0146      |                            | 2    |             | 2    |
| 9/30/98  | 0.019        | 0.019       |                            | 4    |             | 4    |
| 10/31/98 | 0.023        | 0.023       |                            | 2    |             | 2    |
| 11/30/98 | 0.0355       | 0.0355      |                            | 4    |             | 4    |
| 12/31/98 | 0.0186       | 0.0186      | <                          | 2    | <           | 2    |
| 1/31/99  | 0.0595       | 0.0595      | <                          | 2    | <           | 2    |
| 2/28/99  | 0.052        | 0.052       | <                          | 2    | <           | 2    |
| 3/31/99  | 0.0446       | 0.0446      | <                          | 2    | <           | 2    |
| 4/30/99  | 0.0518       | 0.0518      | <                          | 2    | <           | 2    |
| 5/31/99  | 0.058        | 0.058       |                            | 3    |             | 3    |
| 6/30/99  | 0.0217       | 0.0217      | <                          | 4    | <           | 4    |
| 7/31/99  | 0.034        | 0.034       |                            | 8    |             | 8    |
| 8/31/99  | 0.0221       | 0.0221      | <                          | 4    | <           | 4    |
| 9/30/99  | 0.022        | 0.022       | <                          | 2    | <           | 2    |
| 10/31/99 | 0.03         | 0.03        |                            | 3    |             | 3    |
| 11/30/99 | 0.0325       | 0.0325      | <                          | 1    | <           | 1    |
| 12/31/99 | 0.031        | 0.031       | <                          | 1    | <           | 1    |
| 1/31/00  | 0.036        | 0.036       |                            | 2    |             | 2    |
| 2/29/00  | 0.085        | 0.085       | <                          | 1    | <           | 1    |

| Date    | Flow (mgd)   |             | Fecal Coliform (cfu/100ml) |              |             |    |
|---------|--------------|-------------|----------------------------|--------------|-------------|----|
|         | Monthly Mean | Monthly Max |                            | Monthly Mean | Monthly Max |    |
|         |              |             |                            | C            | C           |    |
| 3/31/00 | 0.115        | 0.115       |                            |              | 5           | 5  |
| 4/30/00 | 0.063        | 0.063       | <                          | 1            | <           | 1  |
| 5/31/00 | 0.029        | 0.029       | <                          | 1            | <           | 1  |
| 6/30/00 | 0.05         | 0.05        |                            |              | 3           | 3  |
| 7/31/00 | 0.02         | 0.02        |                            |              | 60          | 60 |

This facility's NPDES permit was inactivated December 31, 2000 and the facility is shutdown.

## APPENDIX C Calculation of Existing and TMDL Loads

### Calculation of Existing Load for 25 Mile Creek at CW-080

Trend Line: Exponential

Equation:  $y = 2E+13 * e^{-3.3237 x}$

x            y  
Exceedence Load

|      |          |
|------|----------|
| 0.10 | 1.43E+13 |
| 0.15 | 1.21E+13 |
| 0.20 | 1.03E+13 |
| 0.25 | 8.71E+12 |
| 0.30 | 7.38E+12 |
| 0.35 | 6.25E+12 |
| 0.40 | 5.29E+12 |
| 0.45 | 4.48E+12 |
| 0.50 | 3.8E+12  |
| 0.55 | 3.21E+12 |
| 0.60 | 2.72E+12 |
| 0.65 | 2.31E+12 |
| 0.70 | 1.95E+12 |
| 0.75 | 1.65E+12 |
| 0.80 | 1.4E+12  |
| 0.85 | 1.19E+12 |
| 0.90 | 1E+12    |

Mean:        5.18E+12

Existing Load:        5.18E+12 cfu/day



| TMDL Load for<br>25 Mile Creek |                          |
|--------------------------------|--------------------------|
| % Exceeded                     | TMDL Load<br>MOS: 0.05 % |
| 10%                            | 3.00E+12                 |
| 15%                            | 2.59E+12                 |
| 20%                            | 2.36E+12                 |
| 25%                            | 2.15E+12                 |
| 30%                            | 1.96E+12                 |
| 35%                            | 1.81E+12                 |
| 40%                            | 1.68E+12                 |
| 45%                            | 1.55E+12                 |
| 50%                            | 1.42E+12                 |
| 55%                            | 1.30E+12                 |
| 60%                            | 1.18E+12                 |
| 65%                            | 1.06E+12                 |
| 70%                            | 9.18E+11                 |
| 75%                            | 8.11E+11                 |
| 80%                            | 7.15E+11                 |
| 85%                            | 6.19E+11                 |
| 90%                            | 5.02E+11                 |
| 1.51E+12 cfu/day               |                          |

## Calculation of Load-Duration Curve

### Samples Violating Standard

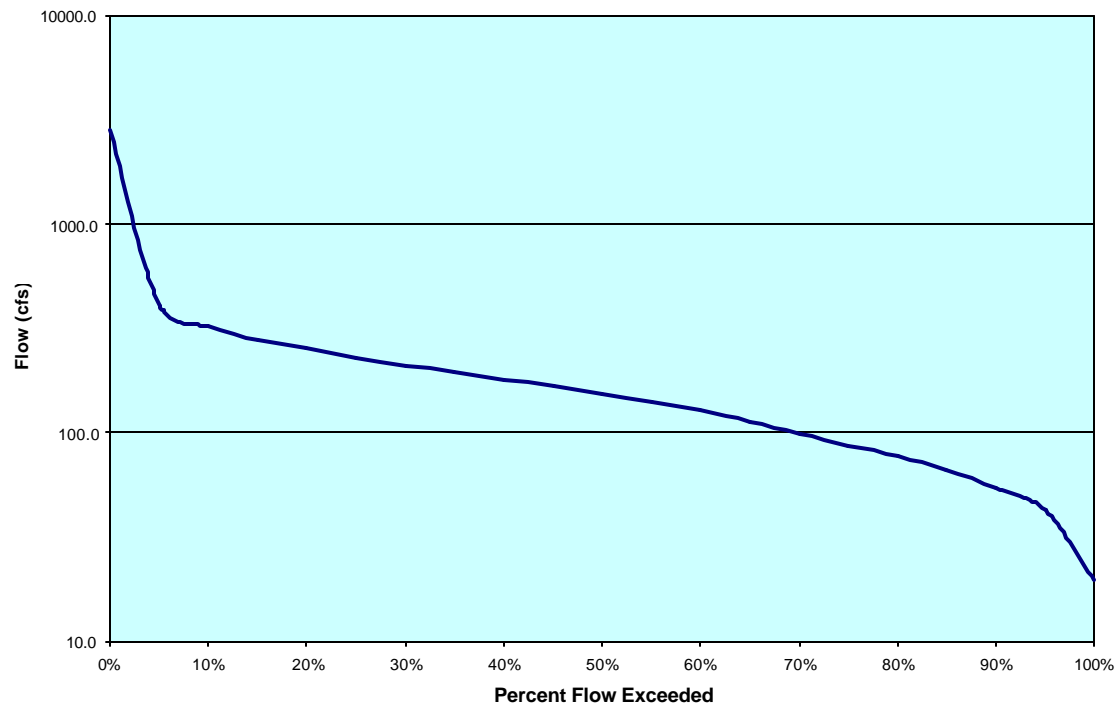
| Date      | FC (cfu/<br>100ml) | Flow | Load     | Rank  | Exceed<br>ence |
|-----------|--------------------|------|----------|-------|----------------|
| 29-May-91 | 2200               | 152  | 8.18E+12 | 7591  | 50.5%          |
| 12-Aug-91 | 5500               | 210  | 2.83E+13 | 10650 | 30.6%          |
| 21-Oct-91 | 460                | 79   | 8.89E+11 | 3246  | 78.8%          |
| 26-Aug-92 | 1200               | 76   | 2.23E+12 | 3055  | 80.1%          |
| 18-Aug-93 | 480                | 58   | 6.81E+11 | 1757  | 88.5%          |
| 5-May-94  | 1700               | 150  | 6.24E+12 | 7468  | 51.3%          |
| 13-Jun-95 | 1100               | 148  | 3.98E+12 | 7317  | 52.3%          |
| 4-Oct-95  | 3900               | 126  | 1.20E+13 | 6059  | 60.5%          |
| 10-Oct-96 | 780                | 597  | 1.14E+13 | 15124 | 1.4%           |
| 9-Mar-98  | 820                | 588  | 1.18E+13 | 15112 | 1.5%           |
| 2-Apr-98  | 740                | 388  | 7.02E+12 | 14447 | 5.8%           |
| 30-Jul-98 | 1100               | 206  | 5.54E+12 | 10520 | 31.4%          |
| 8-Jul-99  | 860                | 46   | 9.68E+11 | 1020  | 93.4%          |

|           |      |    |          |      |       |
|-----------|------|----|----------|------|-------|
| 2-Sep-99  | 460  | 27 | 3.04E+11 | 99   | 99.4% |
| 7-Jun-00  | 420  | 52 | 5.34E+11 | 1384 | 91.0% |
| 15-Aug-01 | 1400 | 23 | 7.88E+11 | 39   | 99.7% |

#### Samples Not Violating Standard

| Date      | FC (cfu/<br>100ml) | Flow | Load     | Rank  | Exceed<br>ence |
|-----------|--------------------|------|----------|-------|----------------|
|           |                    |      |          |       |                |
| 12-Jun-91 | 190                | 84   | 3.90E+11 | 3660  | 76.1%          |
| 2-Jul-91  | 110                | 49   | 1.32E+11 | 1184  | 92.3%          |
| 11-Sep-91 | 250                | 88   | 5.38E+11 | 3878  | 74.7%          |
| 20-May-92 | 120                | 172  | 5.05E+11 | 8713  | 43.2%          |
| 17-Jun-92 | 150                | 222  | 8.15E+11 | 11151 | 27.3%          |
| 28-Jul-92 | 110                | 25   | 6.73E+10 | 54    | 99.6%          |
| 15-Sep-92 | 150                | 42   | 1.54E+11 | 743   | 95.2%          |
| 22-Oct-92 | 60                 | 71   | 1.04E+11 | 2629  | 82.9%          |
| 18-Nov-92 | 110                | 251  | 6.75E+11 | 12185 | 20.6%          |
| 8-Dec-92  | 180                | 164  | 7.22E+11 | 8281  | 46.0%          |
| 19-Jan-93 | 100                | 254  | 6.21E+11 | 12287 | 19.9%          |
| 11-Feb-93 | 110                | 228  | 6.14E+11 | 11395 | 25.7%          |
| 4-Mar-93  | 360                | 292  | 2.57E+12 | 13317 | 13.2%          |
| 1-Apr-93  | 140                | 301  | 1.03E+12 | 13479 | 12.1%          |
| 18-May-93 | 140                | 113  | 3.87E+11 | 5332  | 65.2%          |
| 2-Jun-93  | 150                | 105  | 3.85E+11 | 4924  | 67.9%          |
| 13-Jul-93 | 100                | 42   | 1.03E+11 | 743   | 95.2%          |
| 8-Sep-93  | 320                | 68   | 5.32E+11 | 2475  | 83.9%          |
| 8-Jun-94  | 400                | 131  | 1.28E+12 | 6393  | 58.3%          |
| 9-Aug-94  | 170                | 56   | 2.33E+11 | 1624  | 89.4%          |
| 25-Aug-94 | 170                | 187  | 7.78E+11 | 9501  | 38.1%          |
| 15-Sep-94 | 60                 | 56   | 8.22E+10 | 1624  | 89.4%          |
| 18-Oct-94 | 120                | 184  | 5.40E+11 | 9396  | 38.8%          |
| 9-May-95  | 110                | 88   | 2.37E+11 | 3878  | 74.7%          |
| 5-Jul-95  | 240                | 102  | 5.99E+11 | 4735  | 69.1%          |
| 16-Aug-95 | 200                | 43   | 2.10E+11 | 807   | 94.7%          |
| 20-Sep-95 | 290                | 55   | 3.90E+11 | 1555  | 89.9%          |
| 14-May-96 | 160                | 72   | 2.82E+11 | 2712  | 82.3%          |
| 26-Jun-96 | 160                | 36   | 1.41E+11 | 428   | 97.2%          |
| 22-Jul-96 | 170                | 34   | 1.41E+11 | 324   | 97.9%          |
| 5-Aug-96  | 100                | 69   | 1.69E+11 | 2556  | 83.3%          |
| 14-May-97 | 100                | 95   | 2.32E+11 | 4308  | 71.9%          |
| 19-Jun-97 | 200                | 70   | 3.43E+11 | 2556  | 83.3%          |
| 1-Jul-97  | 80                 | 67   | 1.31E+11 | 2377  | 84.5%          |

|           |     |     |          |      |       |
|-----------|-----|-----|----------|------|-------|
| 5-Aug-97  | 110 | 106 | 2.85E+11 | 4994 | 67.4% |
| 2-Sep-97  | 150 | 68  | 2.50E+11 | 2475 | 83.9% |
| 9-Oct-97  | 300 | 57  | 4.18E+11 | 1688 | 89.0% |
| 27-May-98 | 190 | 139 | 6.46E+11 | 6860 | 55.3% |
| 18-Jun-98 | 90  | 100 | 2.20E+11 | 4670 | 69.6% |
| 5-Aug-98  | 220 | 91  | 4.90E+11 | 4104 | 73.2% |
| 24-Sep-98 | 190 | 119 | 5.53E+11 | 5628 | 63.3% |
| 21-Oct-98 | 220 | 115 | 6.19E+11 | 5440 | 64.5% |
| 19-May-99 | 140 | 84  | 2.88E+11 | 3660 | 76.1% |
| 2-Jun-99  | 110 | 55  | 1.48E+11 | 1555 | 89.9% |
| 19-Aug-99 | 290 | 33  | 2.34E+11 | 273  | 98.2% |
| 21-Oct-99 | 190 | 102 | 4.74E+11 | 4735 | 69.1% |
| 9-May-00  | 140 | 67  | 2.29E+11 | 2377 | 84.5% |
| 18-Jul-00 | 110 | 47  | 1.26E+11 | 1020 | 93.4% |
| 3-Aug-00  | 130 | 98  | 3.12E+11 | 4532 | 70.5% |
| 3-Jan-01  | 160 | 83  | 3.25E+11 | 3591 | 76.6% |
| 1-Feb-01  | 130 | 91  | 2.89E+11 | 4104 | 73.2% |
| 5-Apr-01  | 97  | 151 | 3.58E+11 | 7533 | 50.9% |
| 1-May-01  | 120 | 62  | 1.82E+11 | 2077 | 86.5% |
| 20-Jun-01 | 120 | 45  | 1.32E+11 | 957  | 93.8% |
| 21-Jun-01 | 120 | 35  | 1.03E+11 | 387  | 97.5% |
| 23-Jul-01 | 120 | 31  | 9.10E+10 | 225  | 98.5% |
| 11-Sep-01 | 380 | 29  | 2.70E+11 | 147  | 99.0% |



Flow-duration curve for Twenty-five Mile Creek at CW-080, calculated from flow gauge on Black Creek.

## **APPENDIX D Public Notification**